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ABSTRACT

Many teachers avoid controversial topics because they do not want to upset students or parents, do not know appropriate instructional strategies, and fail to recognize the importance of motivating students through placing science in its relevant context. An example is provided for use in a methods course for helping future high school teachers to use an instructional strategy that involves students in active participation in understanding an important controversial and current topic. The topic concerns biotechnology and the Human Genome Project. (MVL)

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TEACHING CONTROVERSIAL ISSUES OF BIOETHICS

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The Need for Controversial Issues in the Curriculum

Leaders of science education have urged that high-school students should be involved in dealing with the controversial issues arising from such topics as genetically engineered foods. The following quotations support the inclusion of current issues in the high-school curriculum:

The National Academy of Sciences in the *National Science Education Standards* (1996, p. 190) observed:

> The relationship between science and technology is so close that any presentation of science without developing an understanding of technology would portray an inaccurate picture of science. . . . Sometimes scientific advances challenge people's beliefs and practical explanations concerning various aspects of the world (p. 193). . . . There is some research supporting the idea that S-T-S (science, technology, and society) curriculum helps improve student understanding of various aspects of science- and technology-related societal challenges (p. 197).

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AAAS (1993, p. 186) in *Benchmarks for Science Literacy* recommended that

> by the end of the 12th grade, students should know that new varieties of farm plants and animals have been engineered by manipulating their genetic instructions to produce new characteristics. . . Biotechnology has contributed to health improvements in many ways, but its cost and application have led to a variety of controversial social and ethical issues (p. 207).

Many teachers avoid controversial topics because they do not want to upset students or parents, do not know appropriate instructional strategies, and fail to recognize the importance of motivating students through placing science in its relevant context. The following example is used in a methods course for helping future high-school teachers to use an instructional strategy

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that involves their students in active participation in understanding an important controversial and current topic.

Importance of the Controversial Issue in Biotechnology

During the year 2000, $36.8 billion was invested by Wall Street as new capital in biotechnology industries (Abate, 2001). After leading Wall Street during much of 2000, biotech stocks have slipped 14 percent so far in January, 2001. J. P. Morgan investment banking Chief Executive Officer Dan Case predicted that the biotech outlook for 2001 will be "down from 2000 but not as bad as the bears expect."

The Human Genome Project, completed in 2000, was the most expensive scientific project ever attempted. It encouraged the rapid growth of investments in biotechnology industries promising to provide new gene-based medicines. Simultaneously it has led to a host of ethical dilemmas, including individual rights to privacy about their genetic conditions. Francis Collins, chief of the U. S. Human Genome Project, conceded that nobody has come close to solving the ethical and practical aspects of the genome puzzle (Hall, 1999). Various ethical problems can threaten the existence of biotechnology industries because the public could demand the elimination of procedures necessary for these industries.

Products of the biotechnology industries involve the procedure of gene splicing. Some Americans oppose any use of this basic procedure. In 1995, Richard Land, head of the Christian Life Commission of the Southern Baptist Convention said:

> This issue [of genetic engineering] is going to dwarf the pro-life debate within a few years. I think we're on the threshold of mind-bending debates about the nature of human life and animal life. We see altering life forms, creating new life forms, as a revolt against the sovereignty of God and an attempt to be God (Andrews, 1995).

Jeremy Rifkin, president of the Foundation on Economic Trends, has applied for a patent for cloning animals that carry human genes. His goal is to block others from using procedures that could produce a chimera, i.e., a partly human new subspecies providing parts and chemicals useful to medical procedures. Already chimeras exist; animals have been genetically engineered to carry human genes for making products ranging from lactoferrin that can boost the immune system, to alpha anti-trypsin for treating cystic fibrosis. Rifkin and his followers oppose the claiming of a human embryo as intellectual property (Reuters, 1998).

Topic for Jig-Saw Lesson: Genetically Engineered Foods

The *San Francisco Chronicle* reported that Donald Kennedy, editor in chief of *Science* magazine, former president of Stanford University said:

> I think there are three kinds of opposition to the whole area called genetic engineering, and to genetically modified foods and genetically modified organisms for the production of non-food products. One of the concerns is environmental risk, and some that is reasonable and some of it still needs to be evaluated. The second is worry about unforeseen and unknown impacts of introduced substances in food -- and to the extent that people are worried about possible allergens, that has a limited domain of concern. The third is that somehow these methods intervene in an unnatural way in a process that ought not to be intruded upon. A lot of people wouldn't describe that third concern in the same way, I think, but they nevertheless feel it, even if subconsciously. I really don't know what to feel about that (Pearlman, 2000, p. A6).

A handout (provided to participants in the demonstration) presents abstracts from many other articles that give examples of each of the three issues identified by Dr. Kennedy. Participants are invited to deal with these issues to arrive at their own ethical conclusions by use of an instructional technique called Jigsaw. It is an instructional method well described by E. Aronson, N Blaney, C. Stephan, J Sikes, and M. Snapp in 1978: *The Jigsaw Classroom* (Beverly Hills, CA: Sage). A modified version of this procedure includes an emphasis on two

different perspectives. The presentation will include the instructional plan given below:

Steps to Organizing Group Discussions of a Modified Jig-Saw

1. The teacher begins by explaining the first article (a quotation from Donald Kennedy) and describing the following procedures for the lesson:

2. Divide the class into three groups. Each group will read an assigned section, e.g., group one will read section one on "Environmental Risk." Group two reads "Unforeseen Impacts." Allow at least five minutes for the time of silent reading.

3. Divide each of the three reading group into two groups: A. advocates for biotechnology with the belief that more science is good; B. eco-activists who want to preserve the environment and human health with a suspicion that science can cause problems. Assign students to role play these attitudes/perspectives. Each reading group will meet for at least ten minutes to argue their points and arrive at conclusions. Have multiple small groups.

4. Assign at least one advocate of biotechnology and one eco-activist from each reading group to meet with similar representatives of each of the other reading groups. Organize many small new groups with representatives of each reading to explain their conclusions or problems to representatives of the other readings. Allow at least 15 minutes.

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